

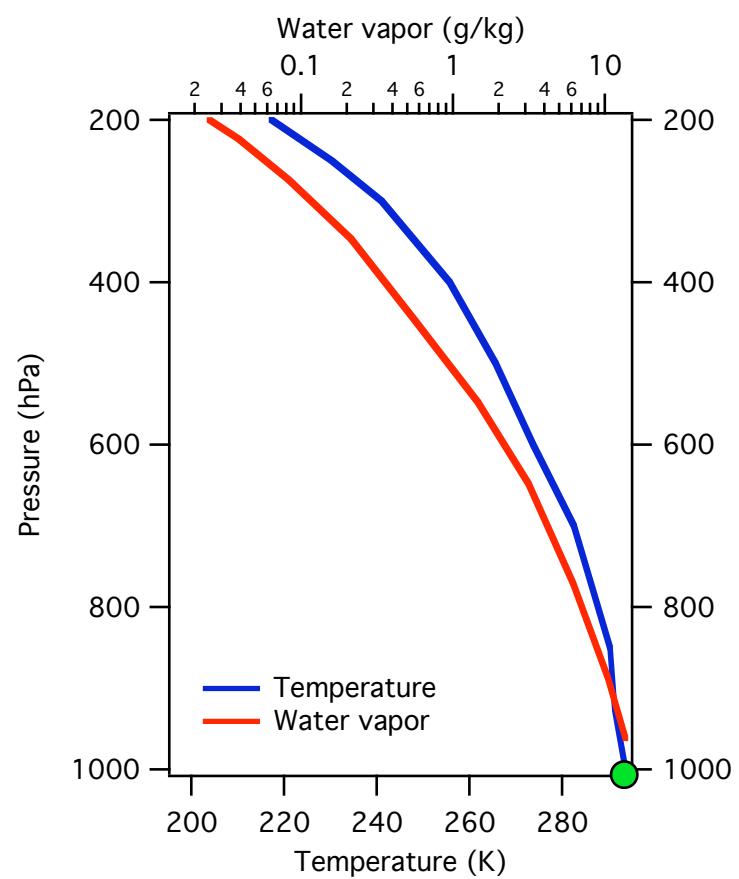
A comparison between CERES OLR and OLR calculated from AIRS temperature & humidity for clear-sky regions

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Department of Atmospheric Sciences

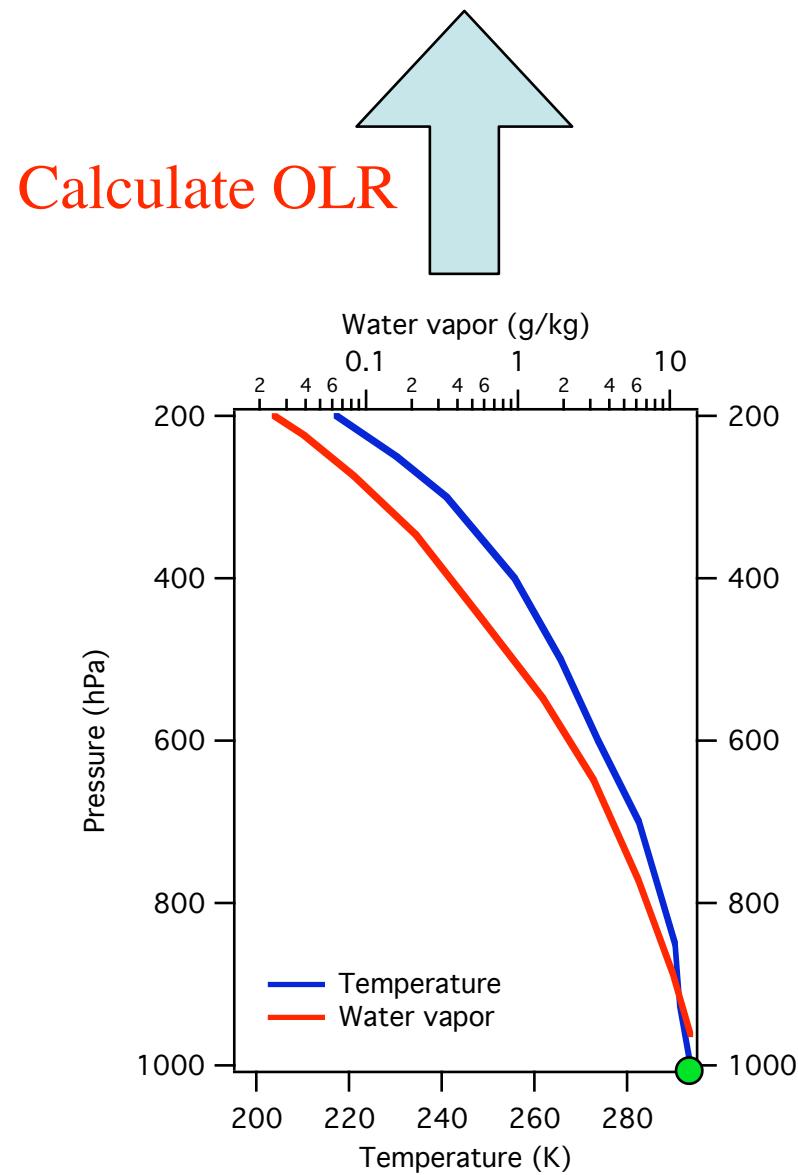
Texas A&M University



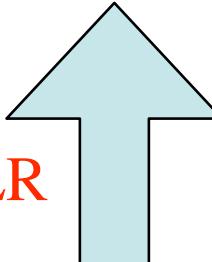


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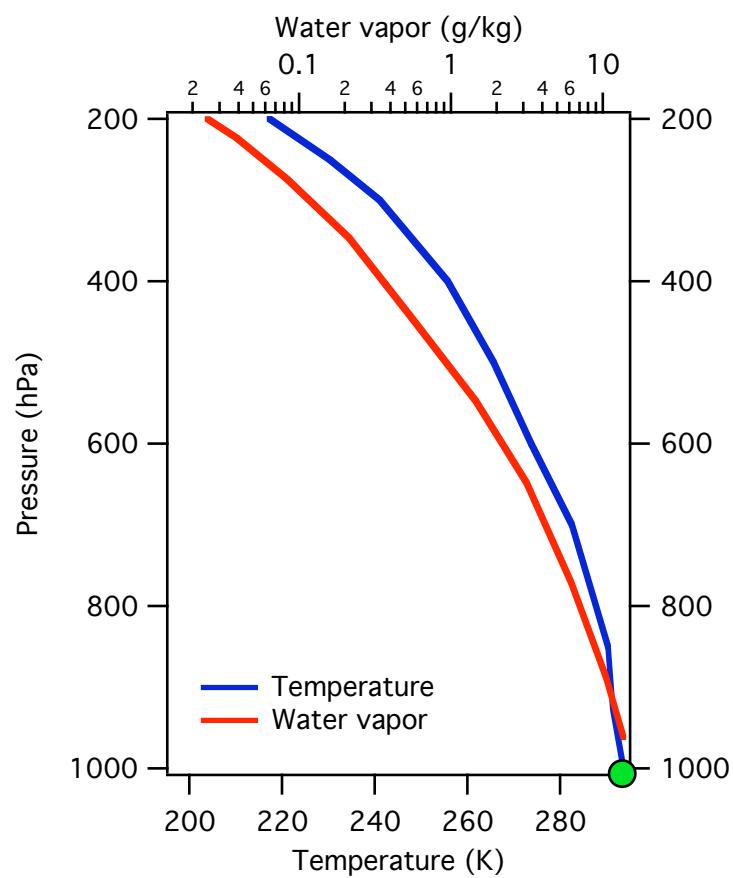
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Calculate OLR



Compare to CERES measurements



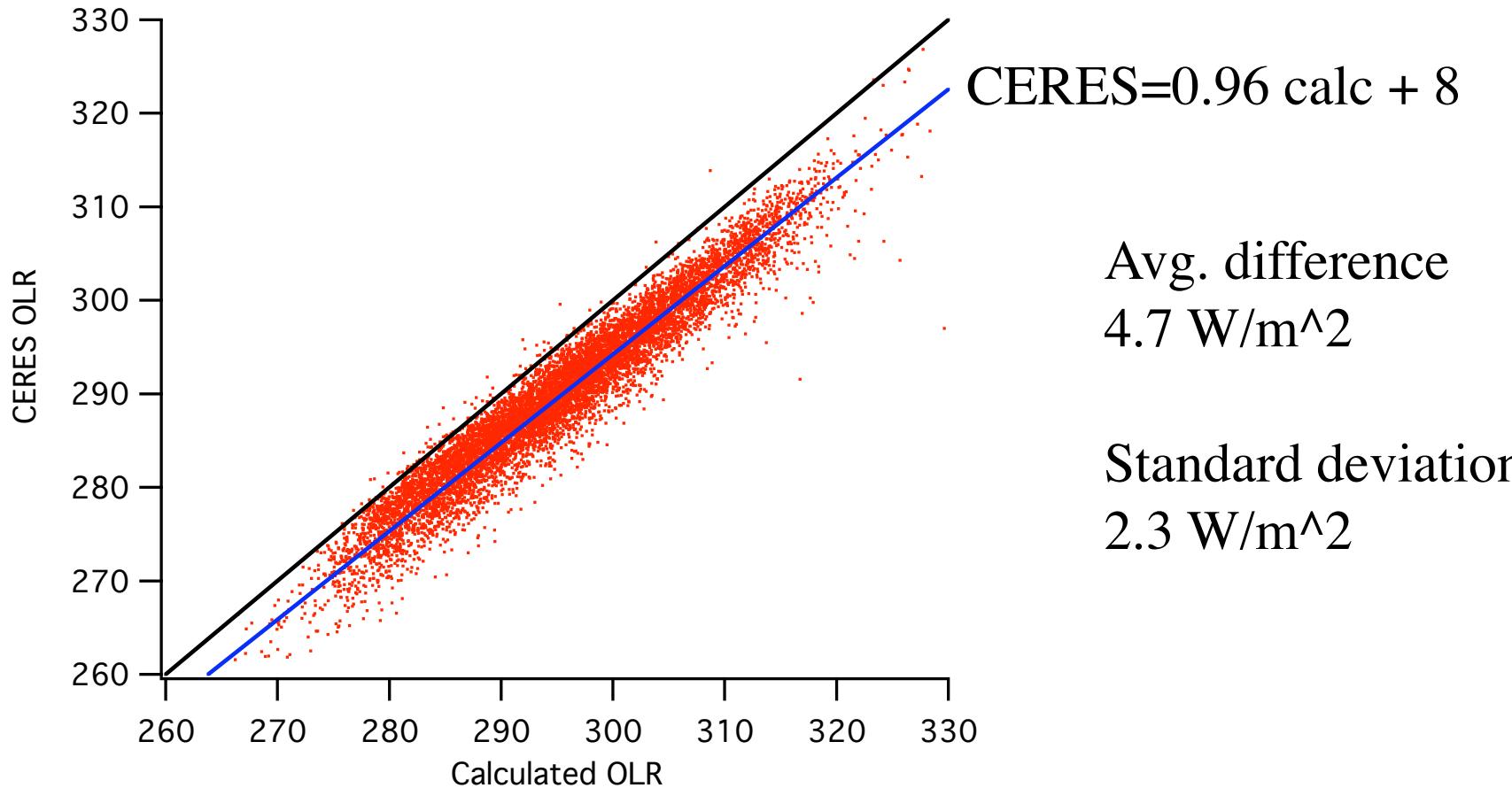
Methodology

- Use CERES Aqua SSF edition 2a data
- Consider those CERES measurements where > 96% of the collocated MODIS cloud-mask measurements are clear
- Combine with AIRS measurements within ~20 km of the CERES measurement
- Calculate TOA flux from CERES surface skin temperature and AIRS profiles of q, T, and O₃
- Nighttime, ocean, March and September 2005

Model

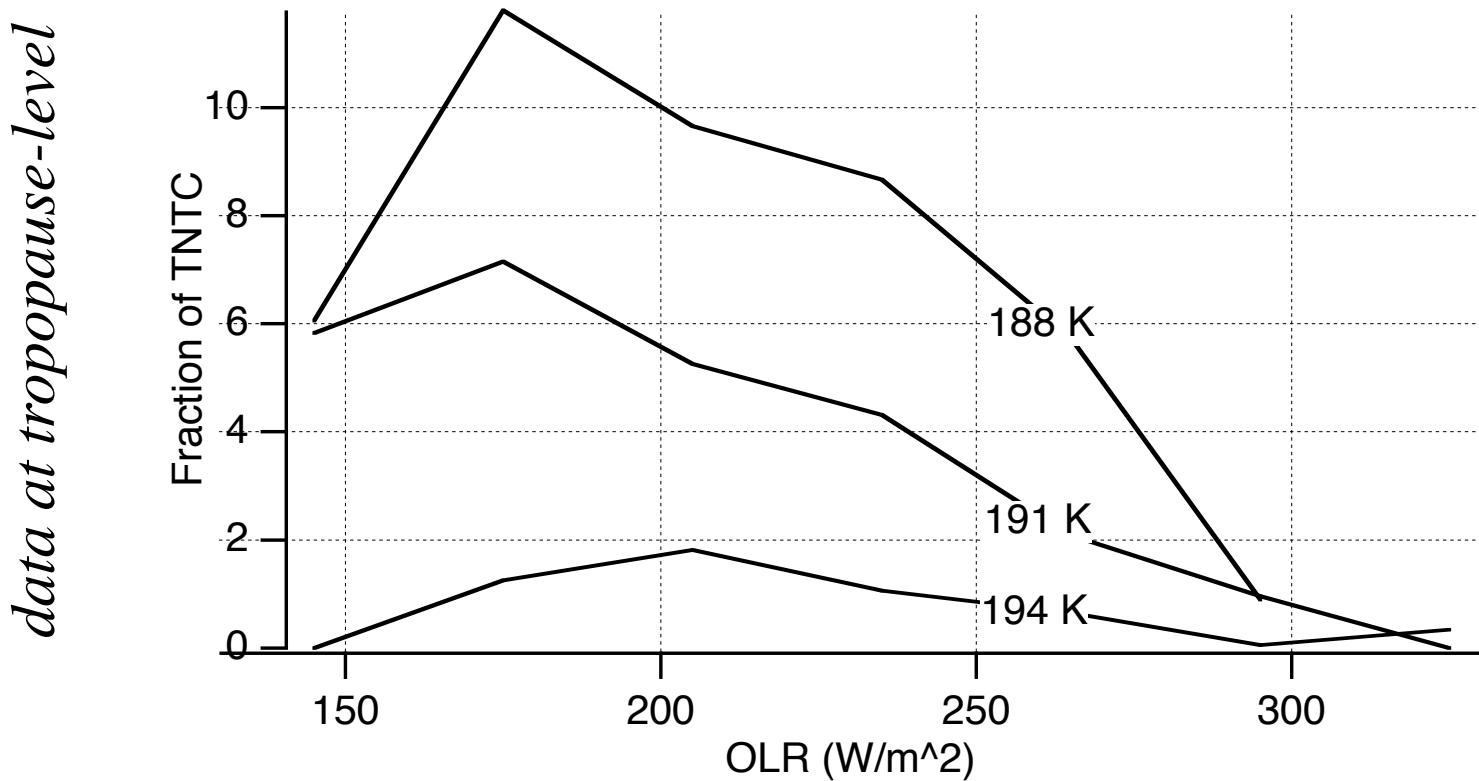
- Chou et al., 2001: A Thermal Infrared Radiation Parameterization for Atmospheric Studies. NASA Tech. Memo. 104606, vol. 19, 1-55.
- The infrared spectrum ($0\text{--}3000\text{ cm}^{-1}$) is divided into 9 bands and a subband, in total 10 bands
- Using the Air Force Geophysical Laboratory HITRAN data base (1996 version)
- The parameterization includes the absorption due to major gaseous absorption (water vapor, CO_2 , O_3) and most of the minor trace gases (N_2O , CH_4 , CFC's) as well as clouds and aerosols.
- The gaseous transmission function is computed either using the k-distribution method or the table look-up method.
- Accuracy: within 1% of the high spectral-resolution line-by-line calculation
- In this calculation, band 9 ($1900\text{--}3000\text{ cm}^{-1}$) is excluded to match with CERES TOA flux band ($50\text{--}2000\text{ cm}^{-1}$). The flux at 30 km between 1900 and 2000 cm^{-1} is 0.9 W m^{-2} using tropical atmosphere.
- Vertical atmospheric profiles from AIRS are used, including temperature, water vapor, and ozone profile
- Atmosphere is divided into 100 layers from surface to 100 km and the AIRS profiles are interpolated at each level.

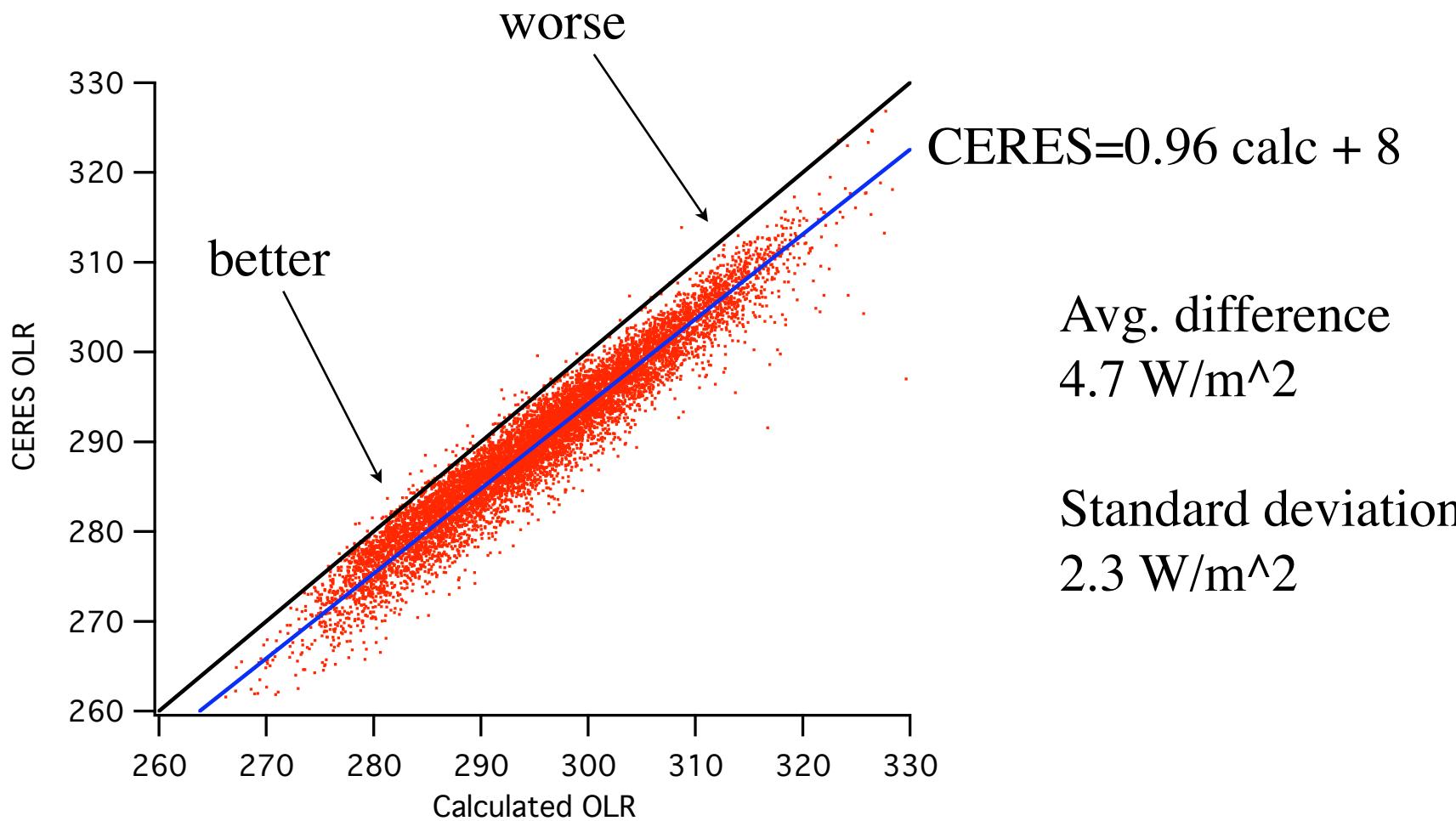




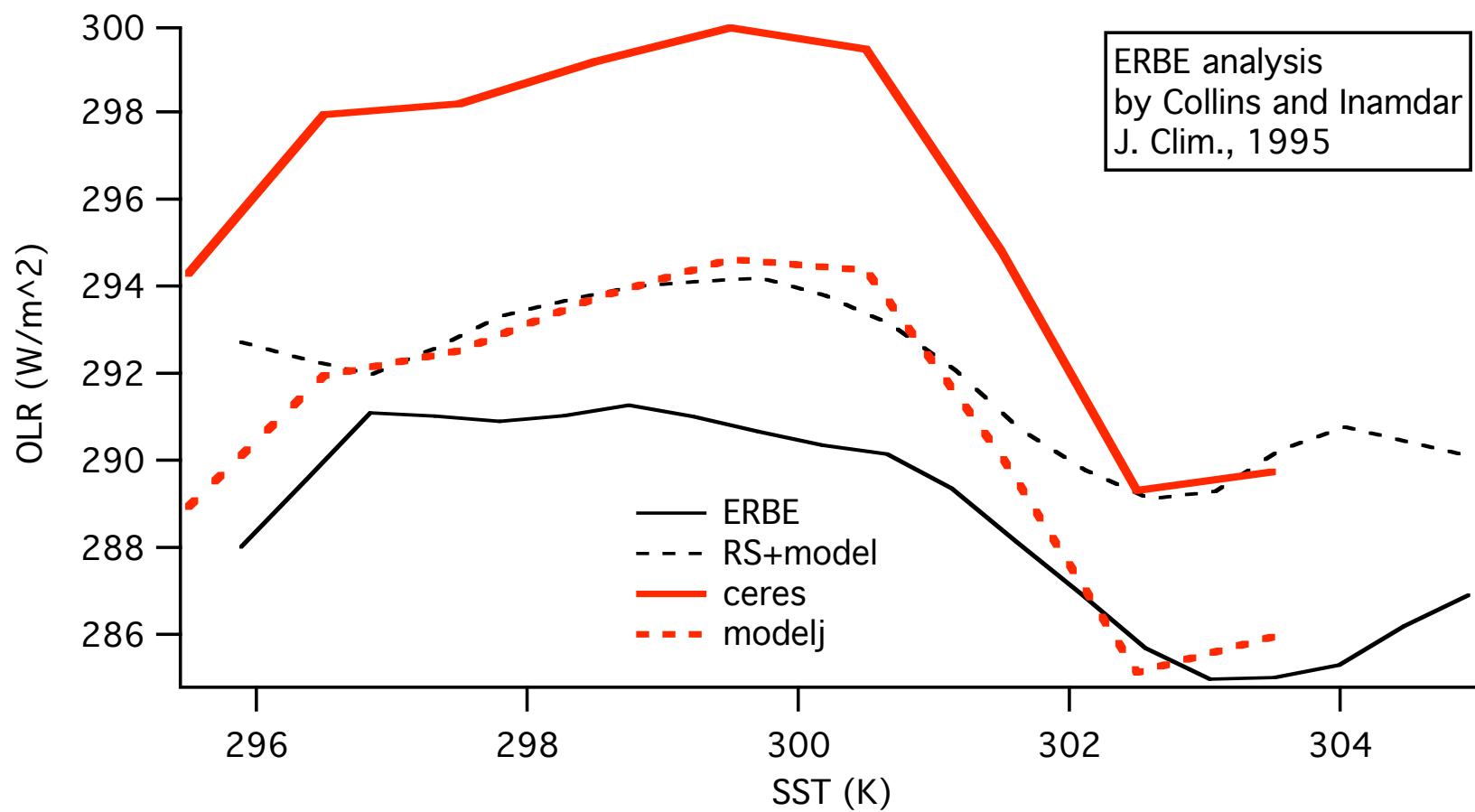
Sept. 2005, 30°N-30°S

Dessler et al. (2006), Tropopause-level thin cirrus coverage revealed by ICESat/
Geoscience Laser Altimeter System, *J. Geophys. Res.*, 111, D08203, DOI:
10.1029/2005JD006586.



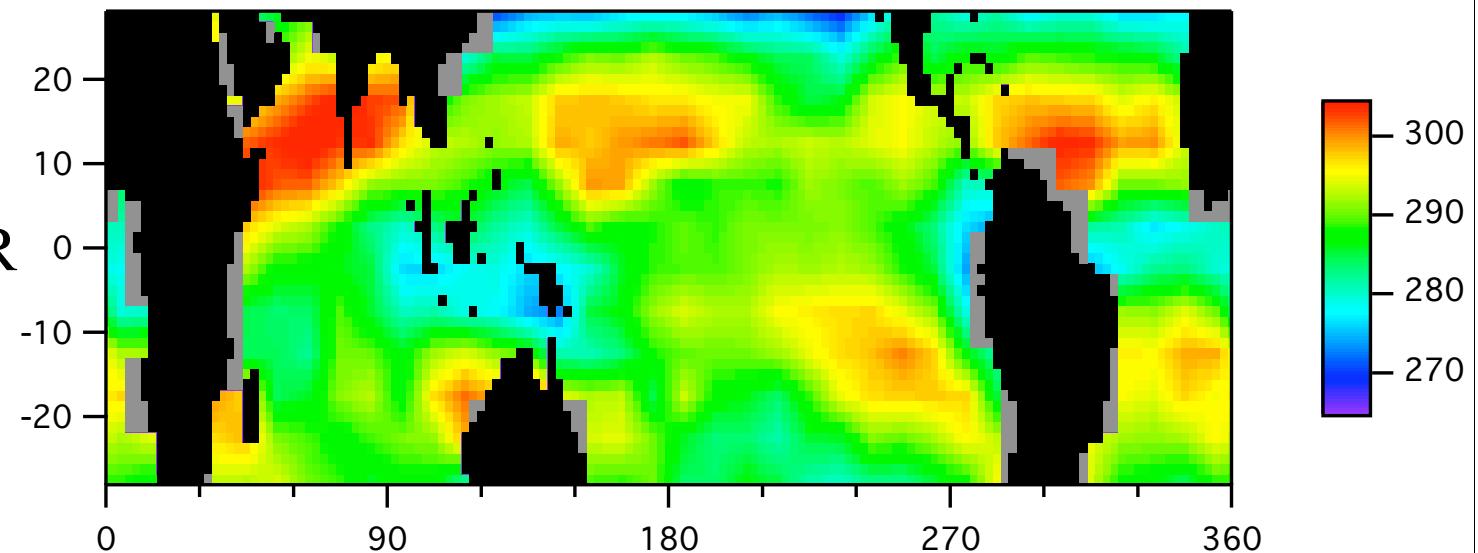


Sept. 2005, 30°N-30°S

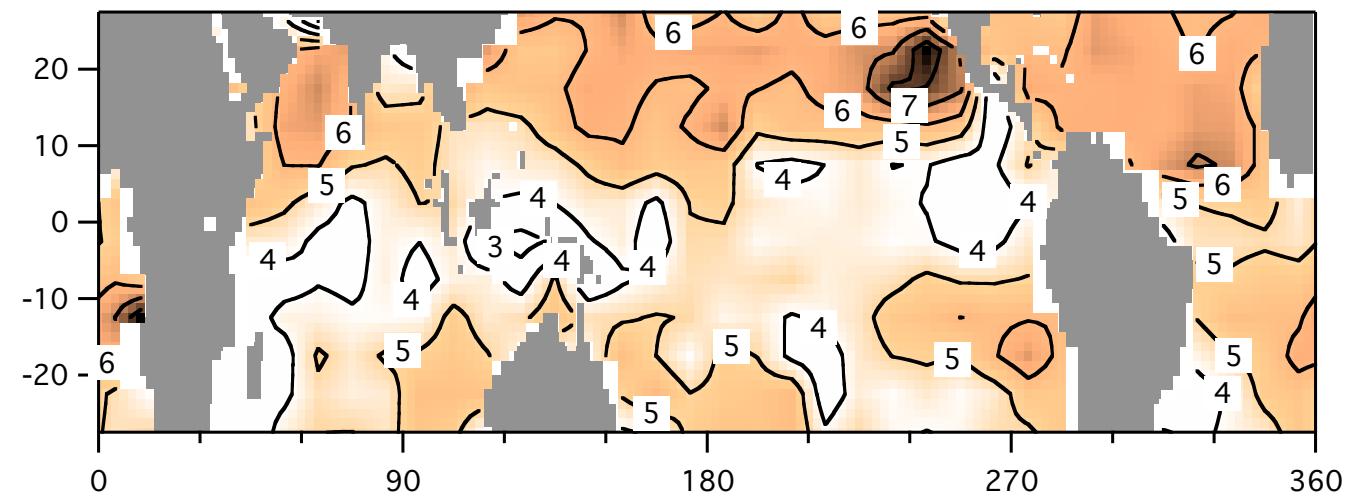


ERBE analysis
by Collins and Inamdar
J. Clim., 1995

Clear-sky OLR

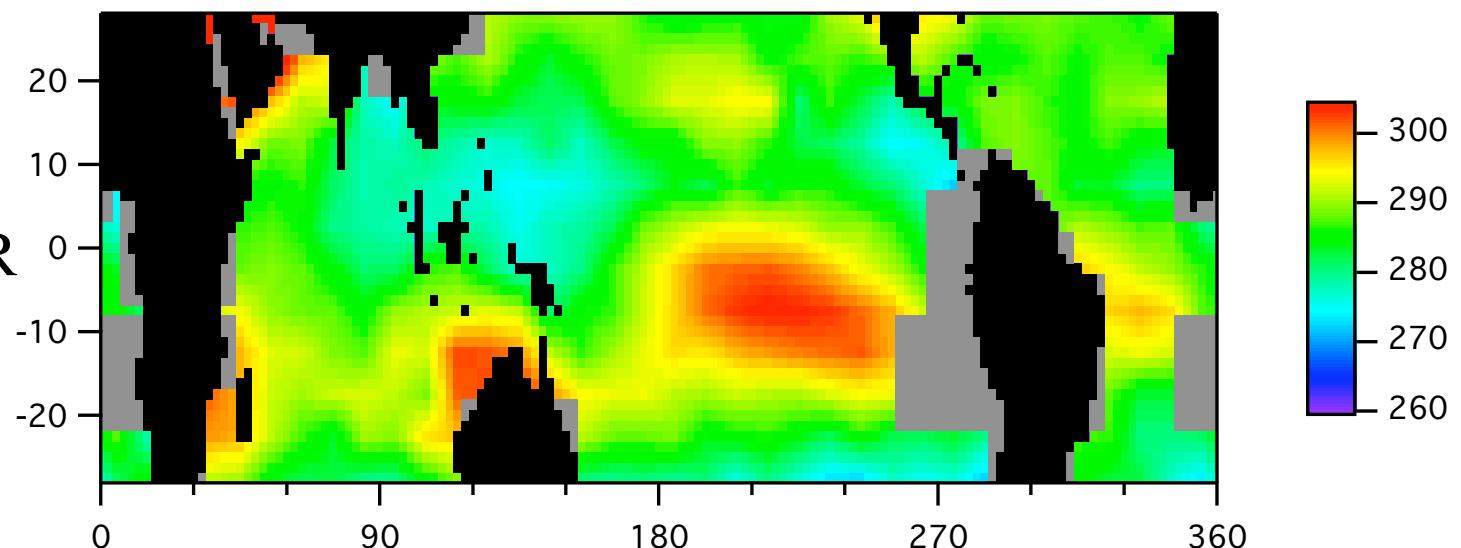


model - meas.

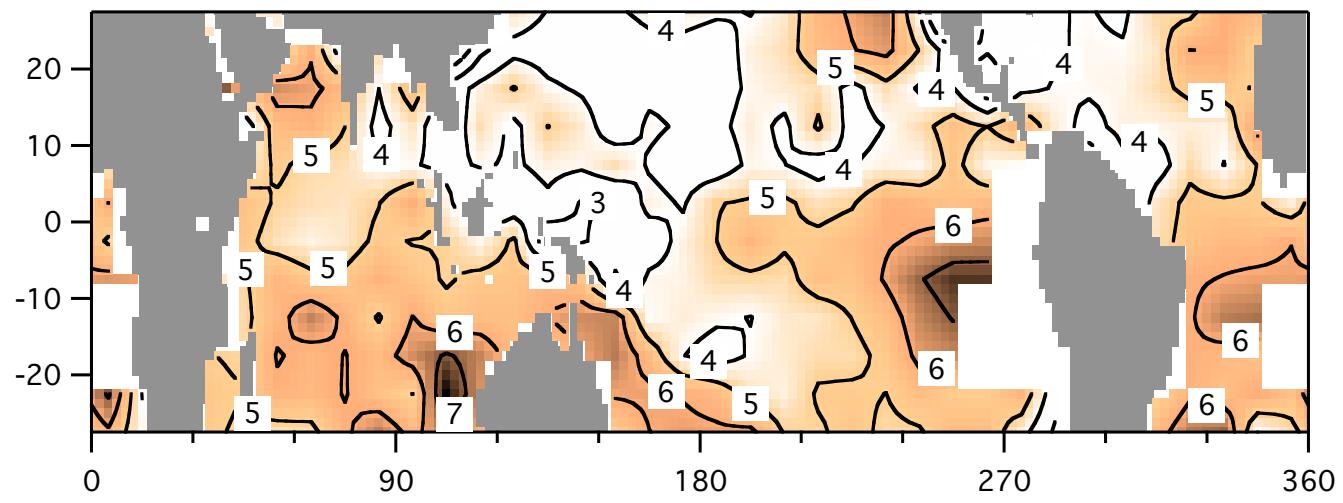


Clear-sky OLR

Sept. 2005

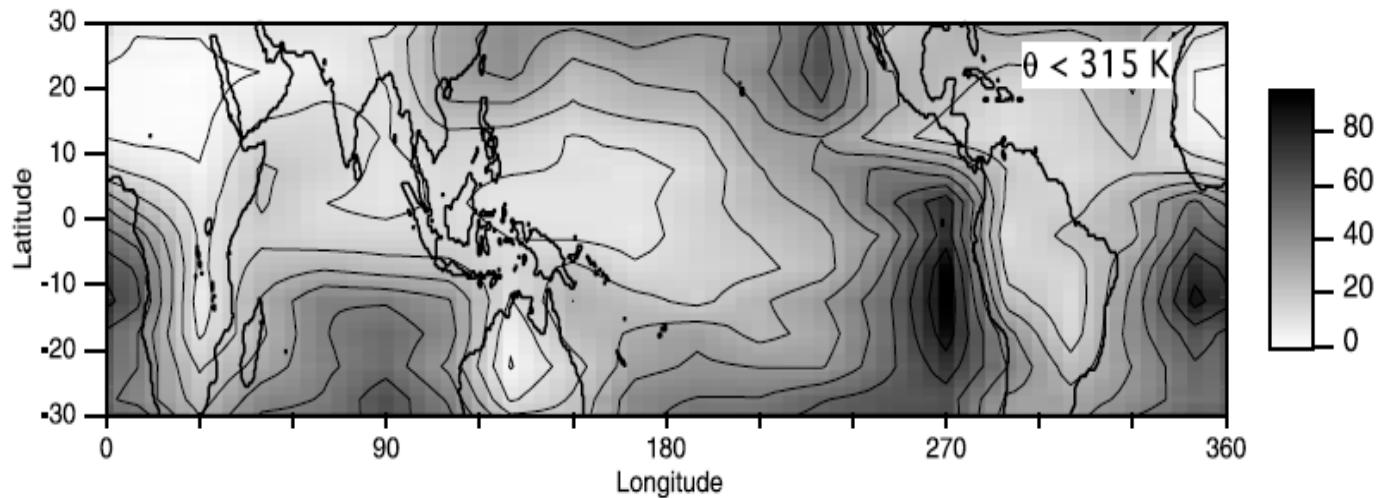


model - meas.

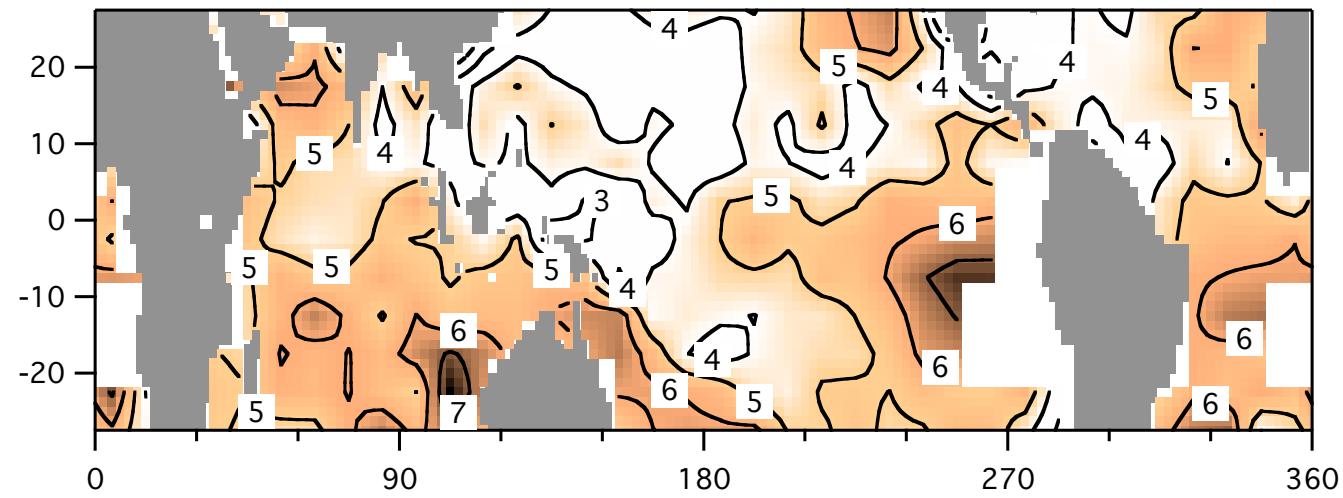


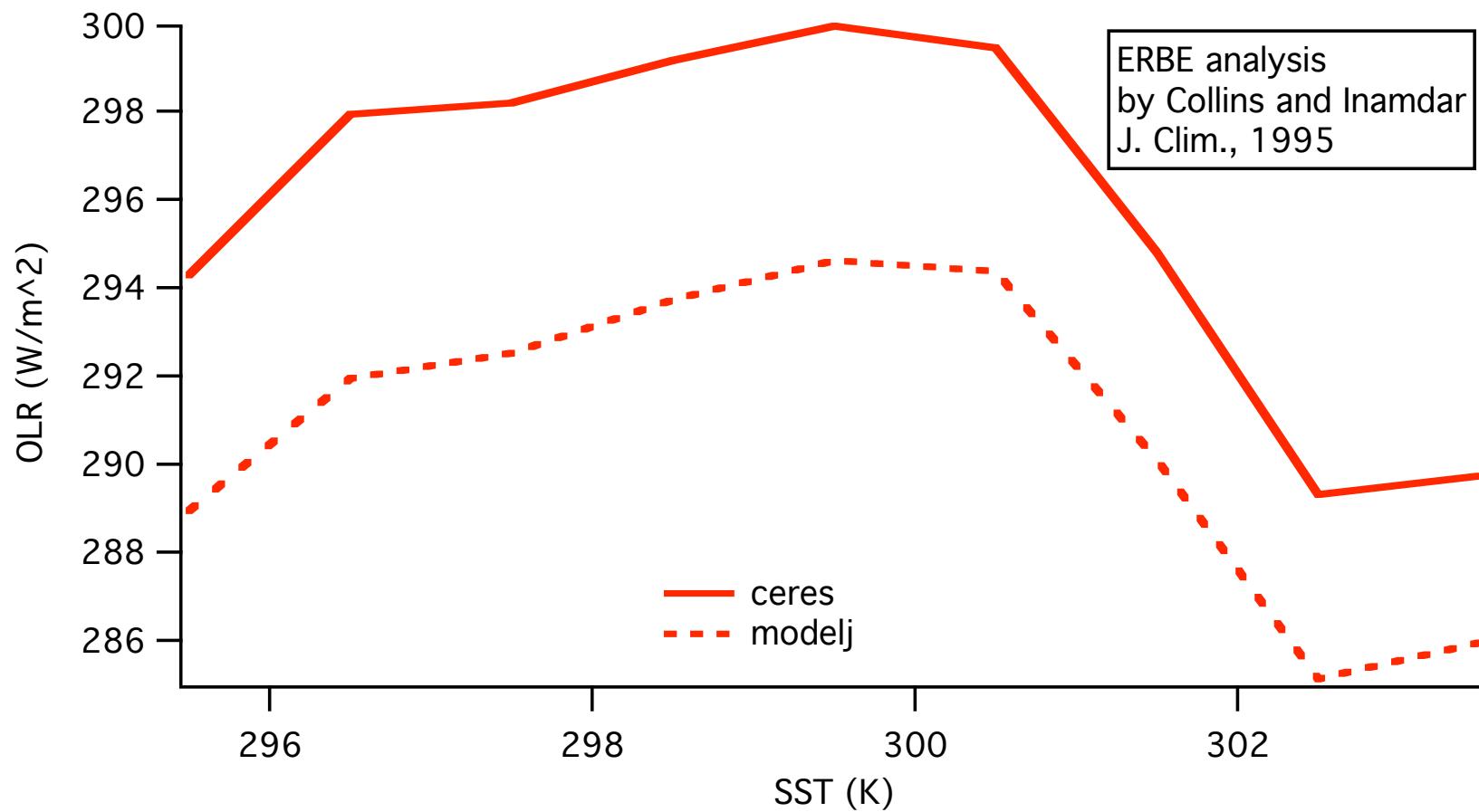
Dessler, A.E., S.P. Palm, and J.D. Spinhirne (2006), Tropical cloud-top height distributions revealed by the Ice, Cloud, and Land Elevation Satellite (ICESat)/Geoscience Laser Altimeter System (GLAS), *J. Geophys. Res.*, 111, D12215, DOI: 10.1029/2005JD006705.

Oct. 2003



Sept. 2005

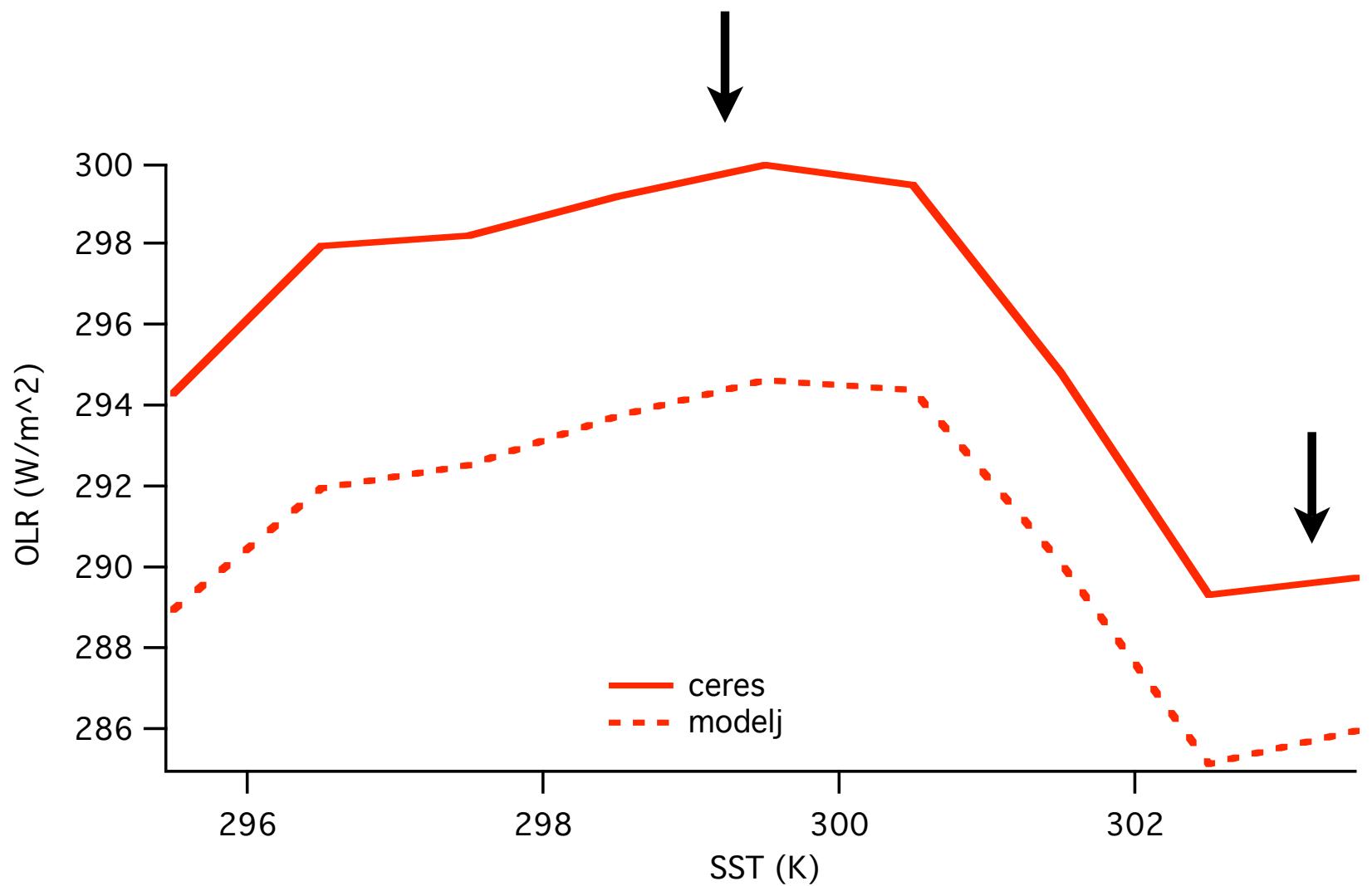




data from 9/05

14

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data from 9/05

15

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Compare to 299 to 303 K

303 K OLR
289.3 W/m²

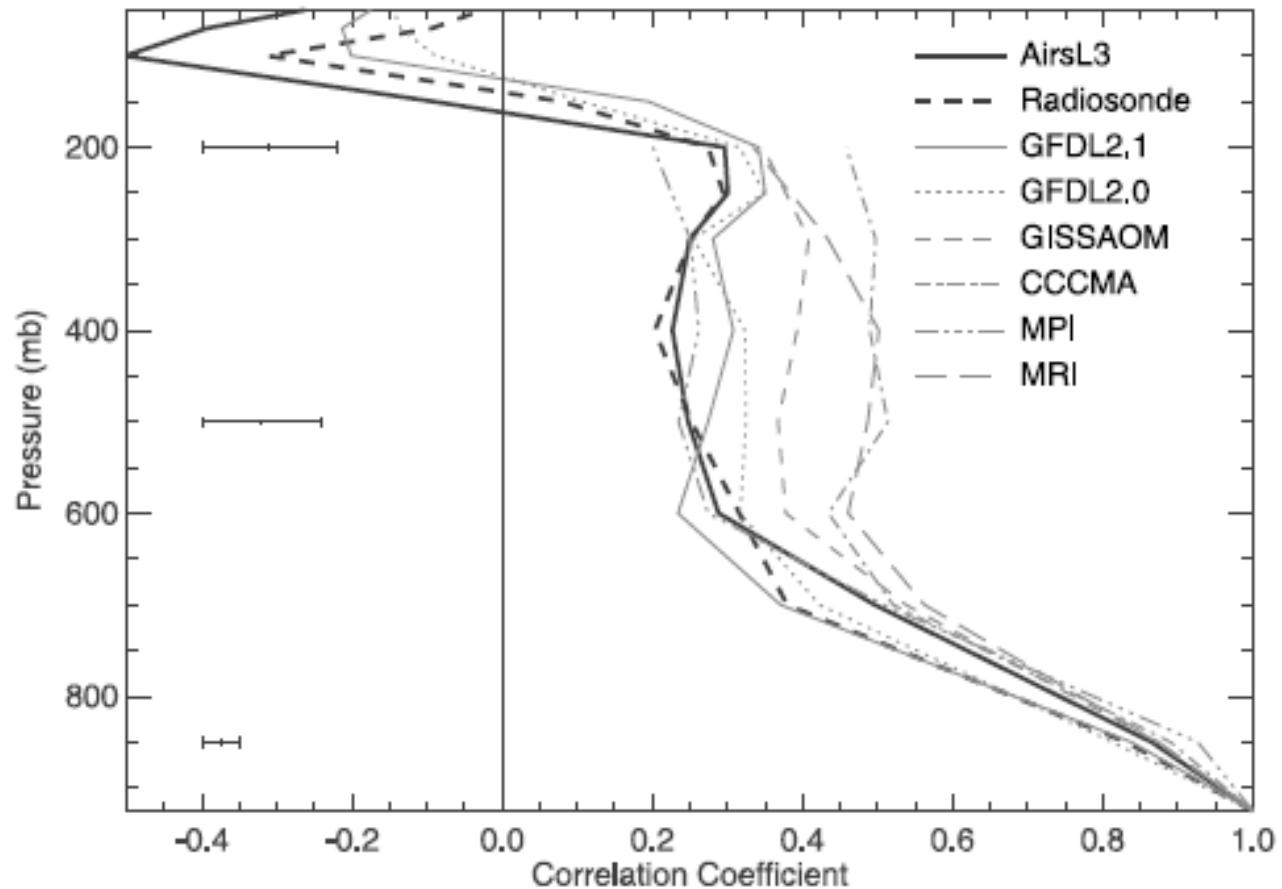
299 K OLR
297.7 W/m²

Δ OLR
-8.4 W/m²

Surface T	2.0
Lower Trop T	2.8
Upper Trop T	0.6
Lower Trop q	-7.9
Upper Trop q	-6.3

Lower Trop = 1000-500 hPa, Upper Trop = 500-100 hPa

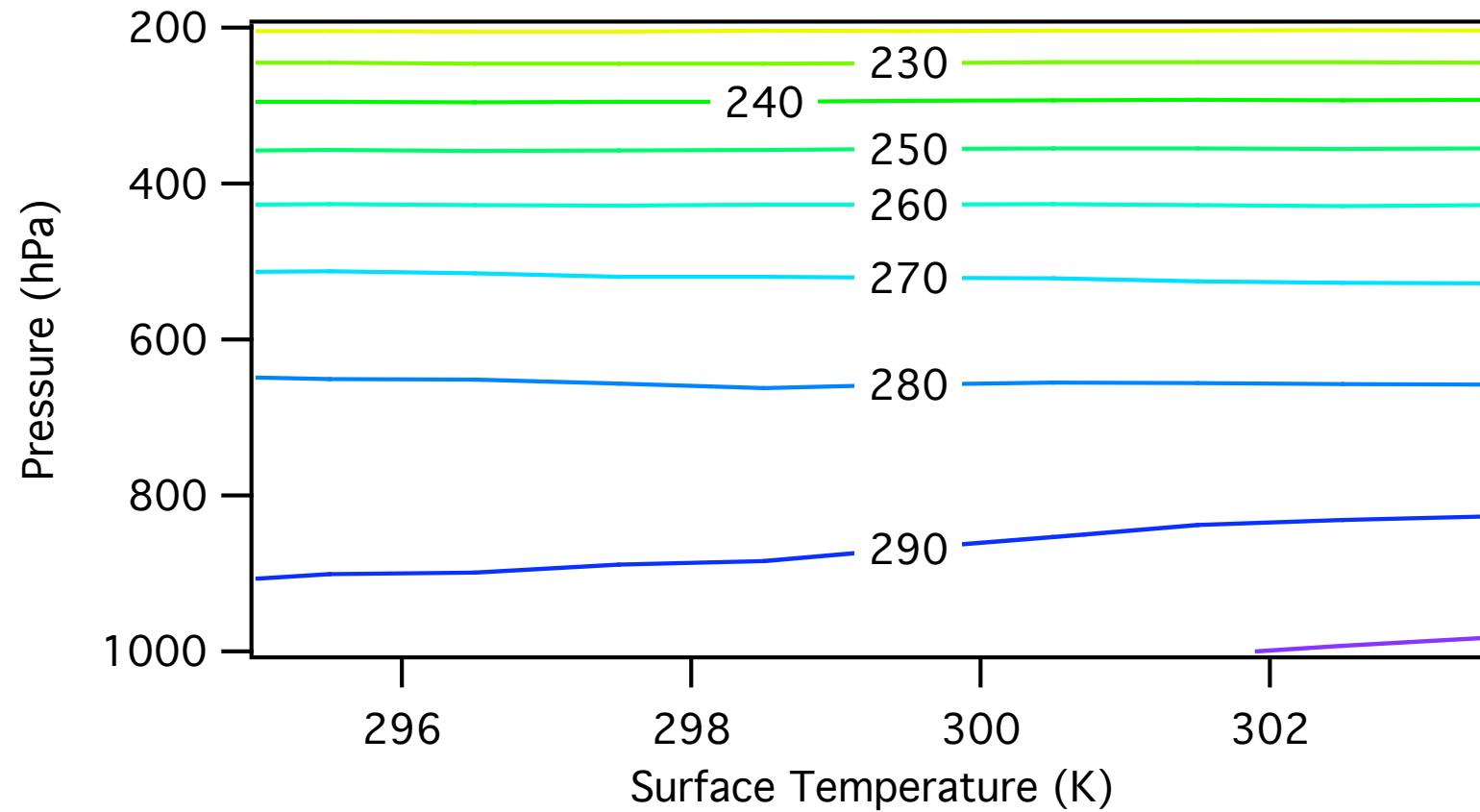
data from 9/05



Correlation between the tropical averaged (20 N–20 S) daily temperature at 925 hPa and the tropical averaged daily temperature at other levels of the troposphere. AIRS data are represented by the black solid line, radiosonde by the black dashed line, and GCMs by the gray lines. 95% confidence intervals at 850 hPa, 500 hPa, and 200 hPa are plotted.

Wu, Dessler, and North (2006), Analysis of the correlations between atmospheric boundary-layer and free-tropospheric temperatures in the Tropics, *Geophys. Res. Lett.*, 33, L20707, DOI: 10.1029/2006GL026708.

Variations of T with SST

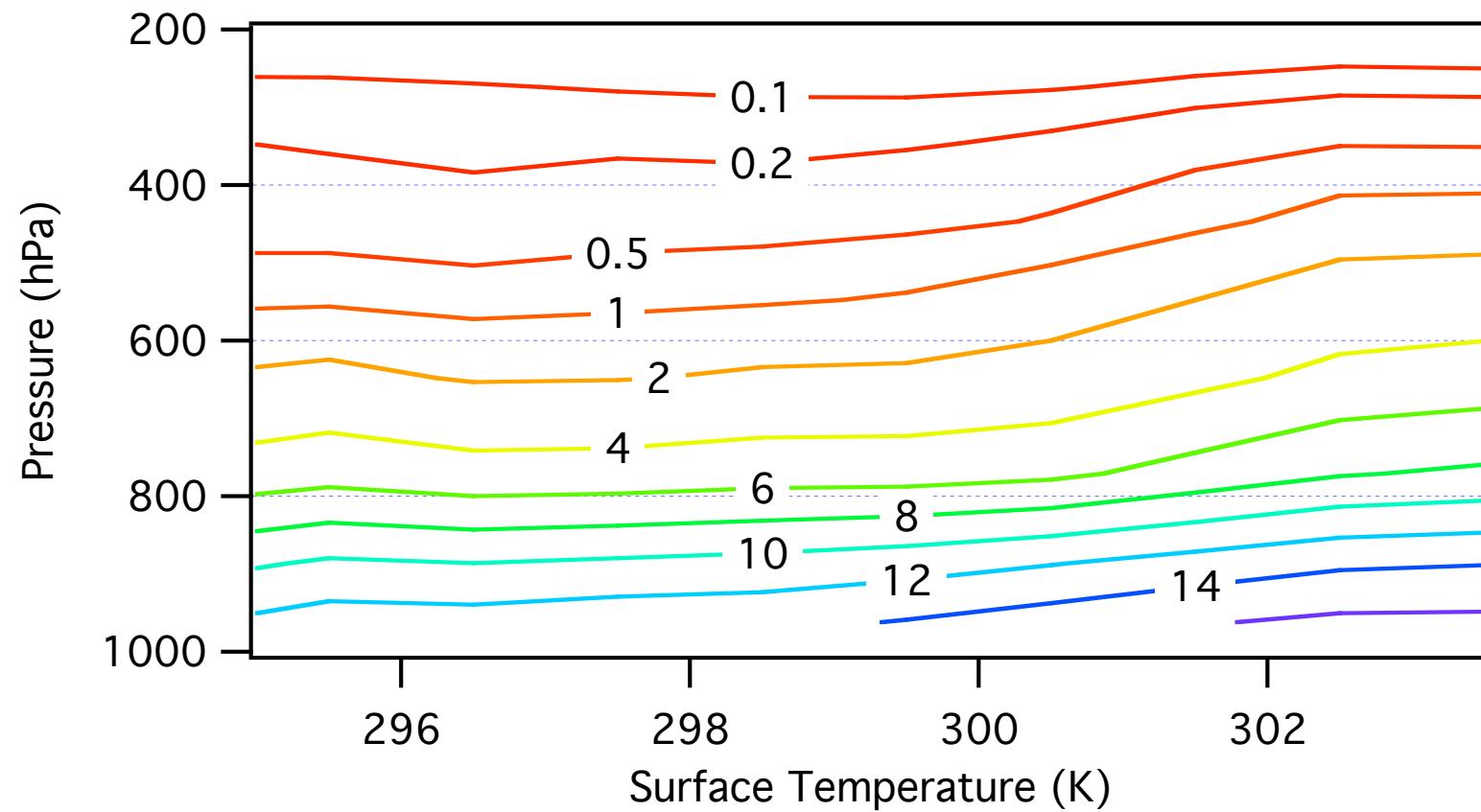


data from 9/05

18

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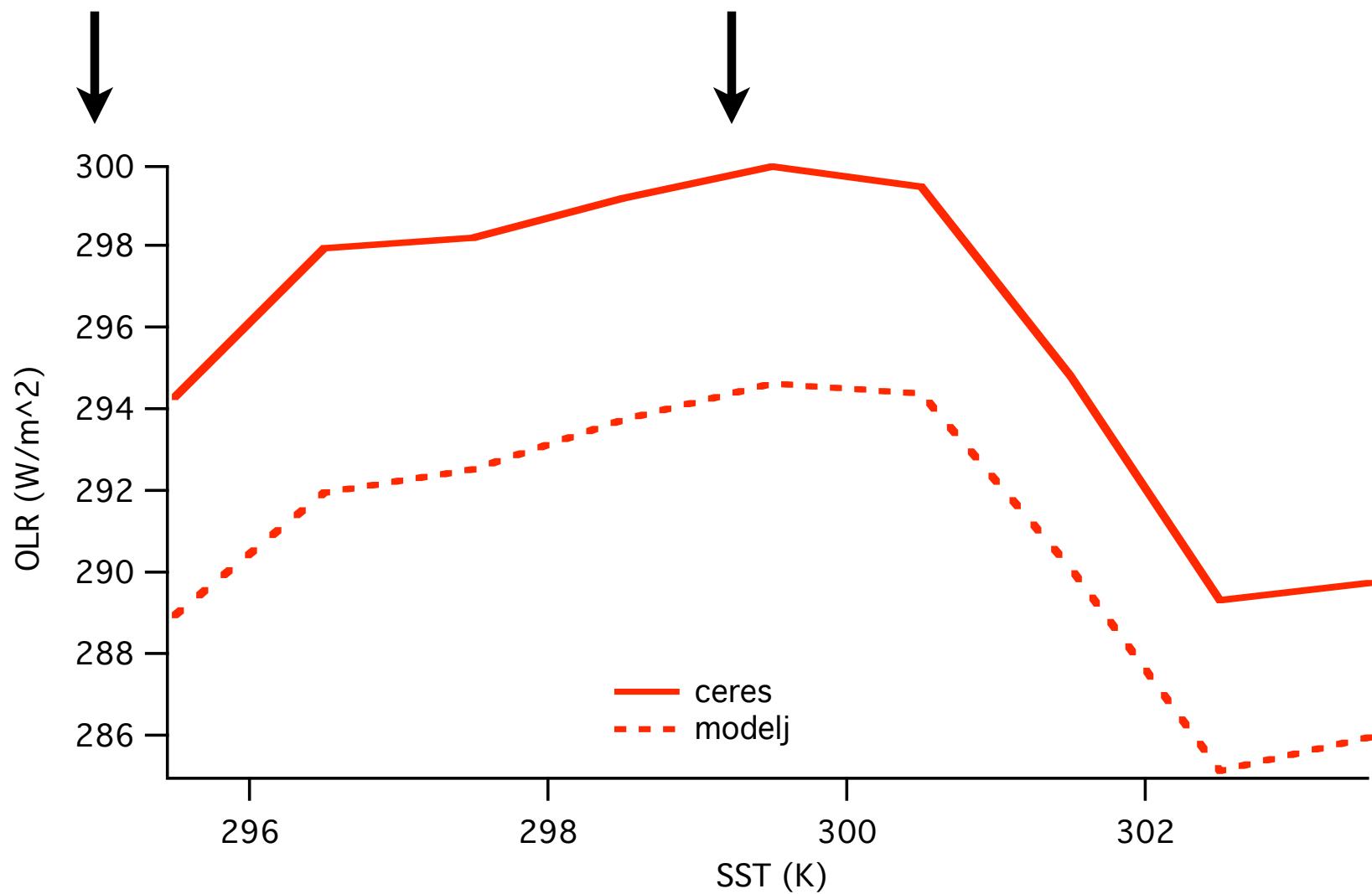
Variations of q with SST



data from 9/05

19

ATM



data from 9/05

20

ATM

Compare to 295 to 299 K

299 K OLR
297.7 W/m²

295 K OLR
285.3 W/m²

ΔOLR
12.4 W/m²

	299 K to:	295 K	303 K
Surface T	8.3	2.0	
Lower Trop T	9.7	2.8	
Upper Trop T	4.8	0.6	
Lower Trop q	-7.6	-7.9	
Upper Trop q	-3.2	-6.3	

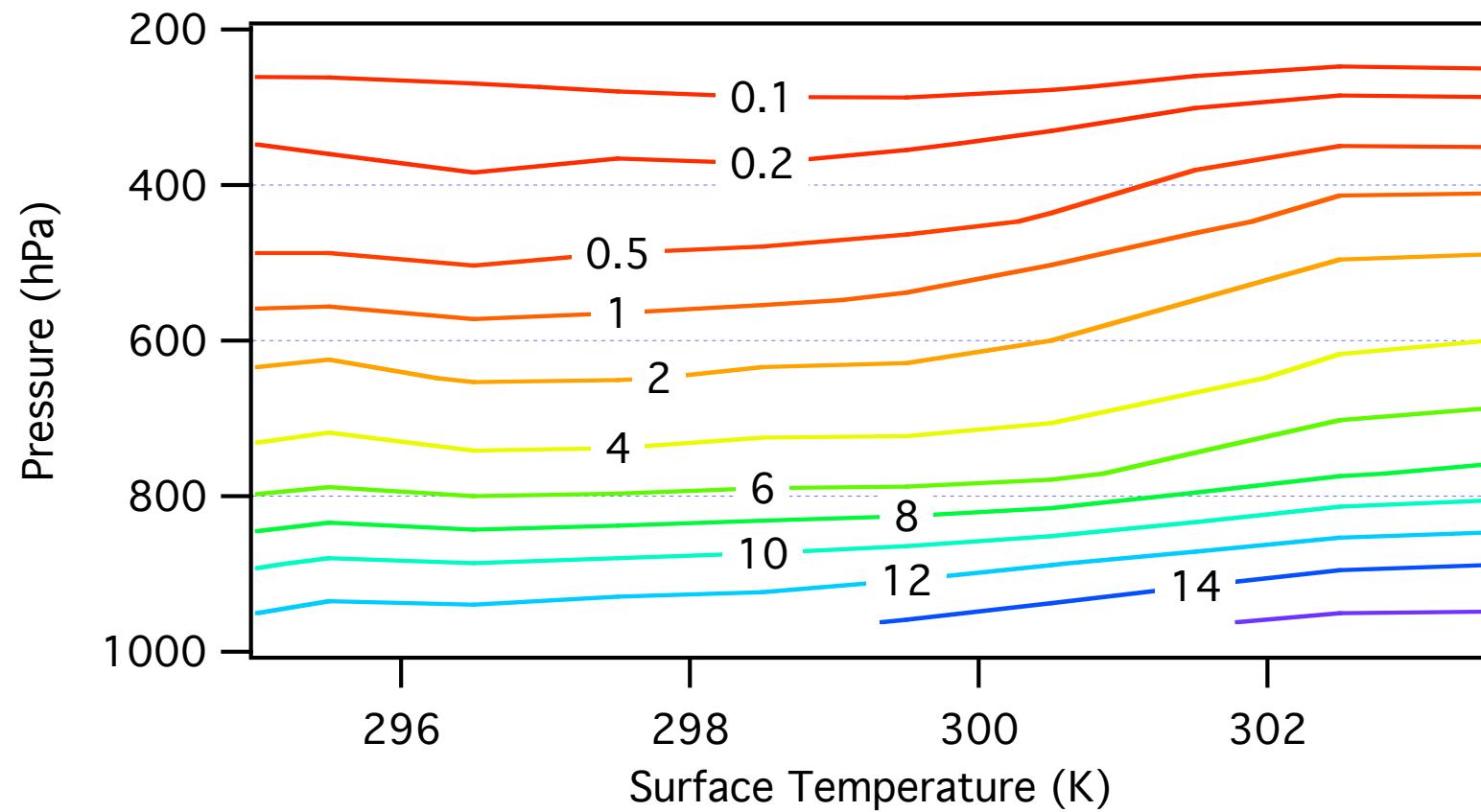
Lower Trop = 1000-500 hPa, Upper Trop = 500-100 hPa

data from 9/05

21



Variations of q with SST

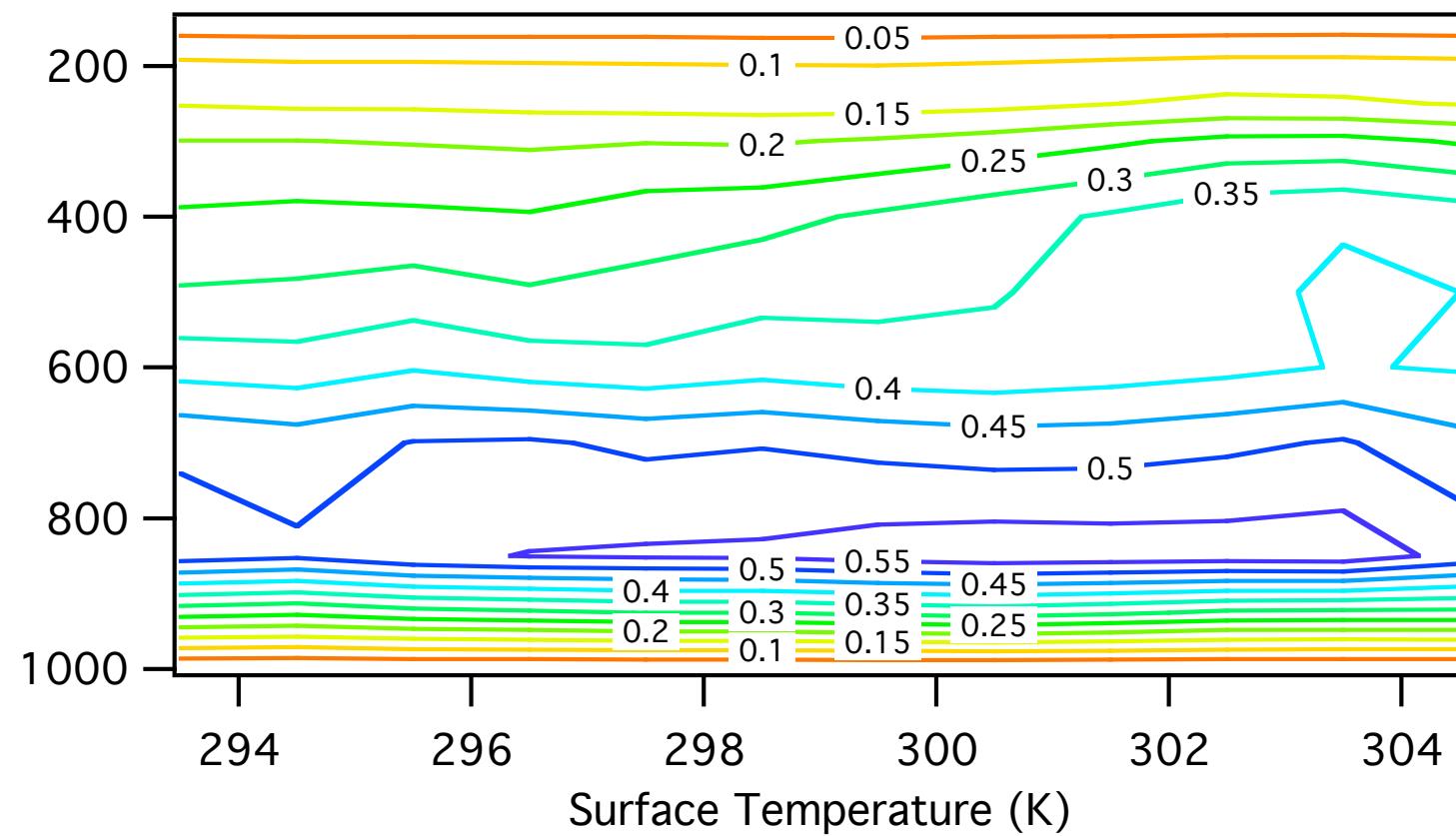


data from 9/05

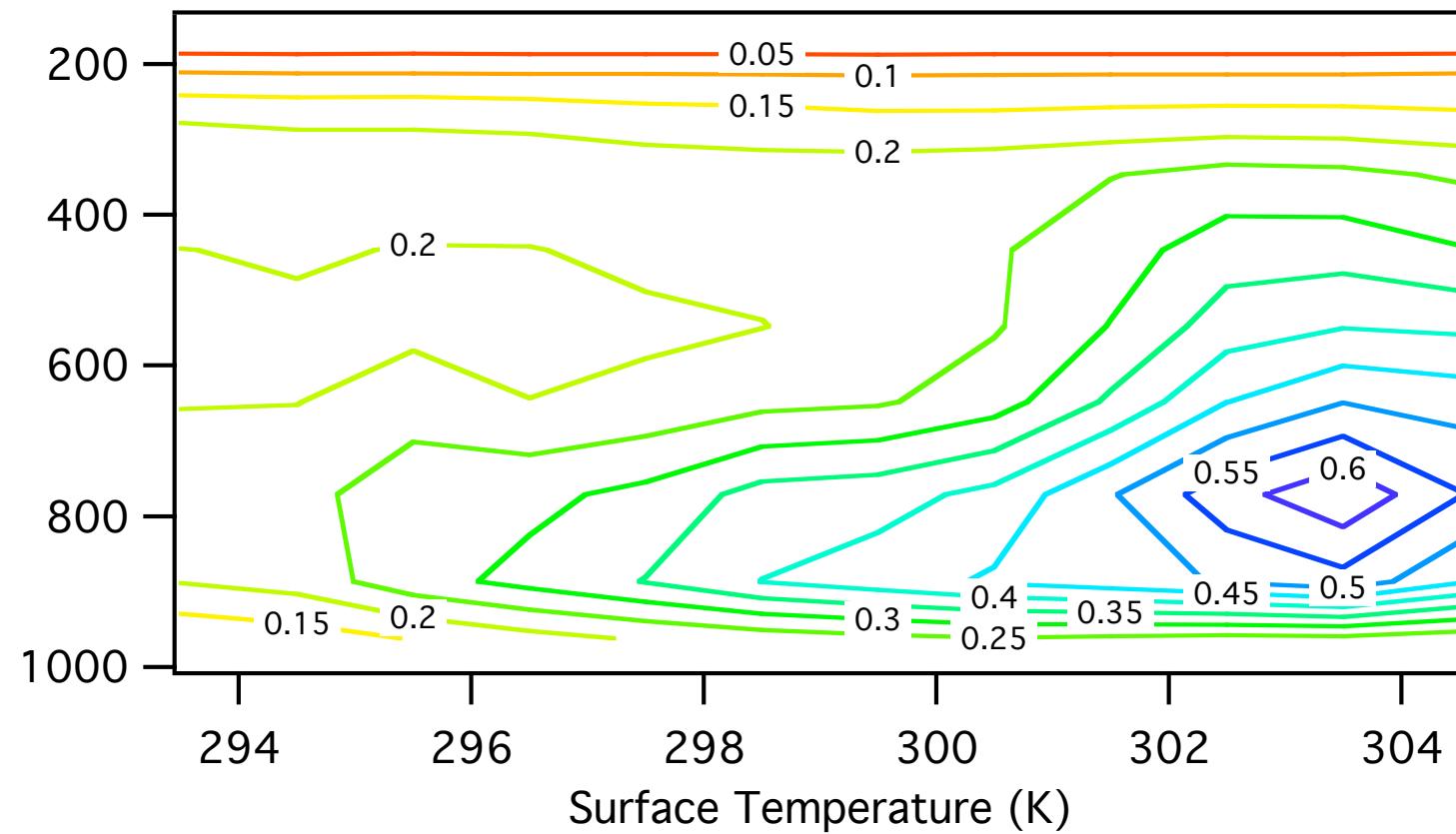
22

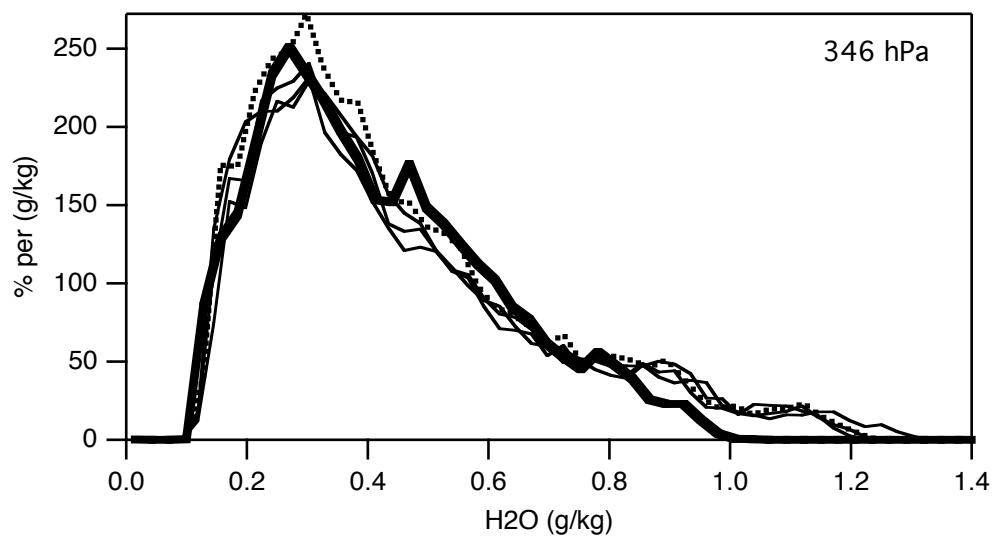
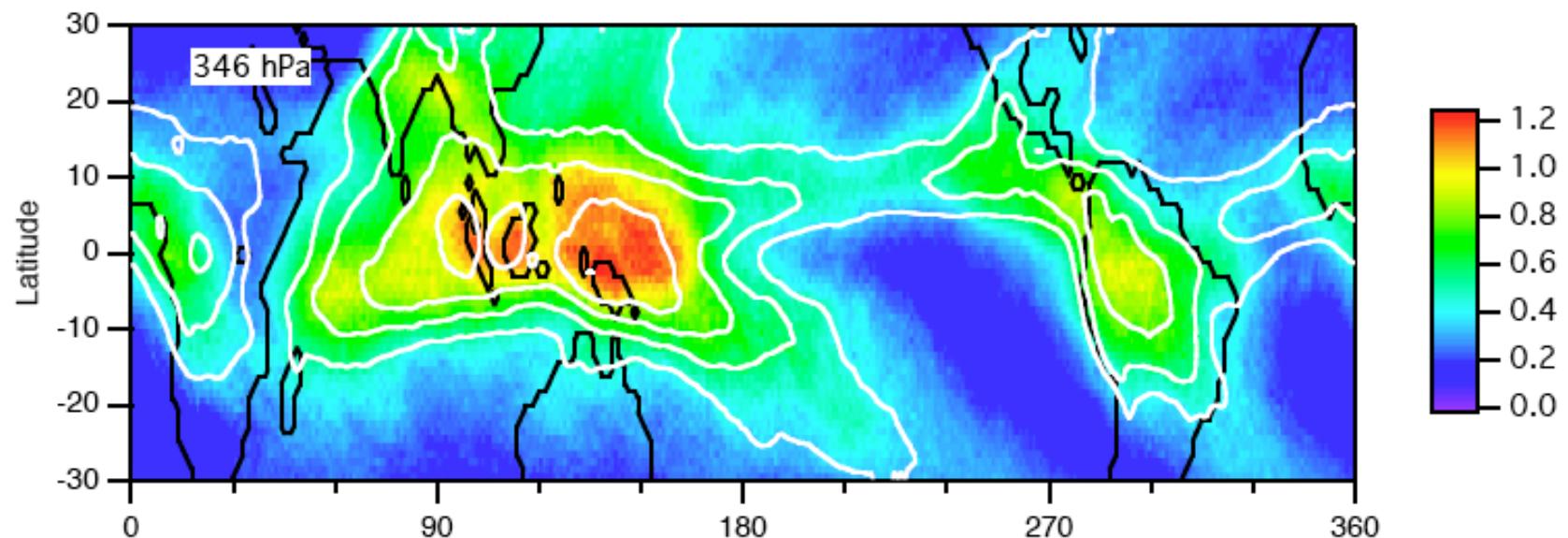
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T's effect on OLR



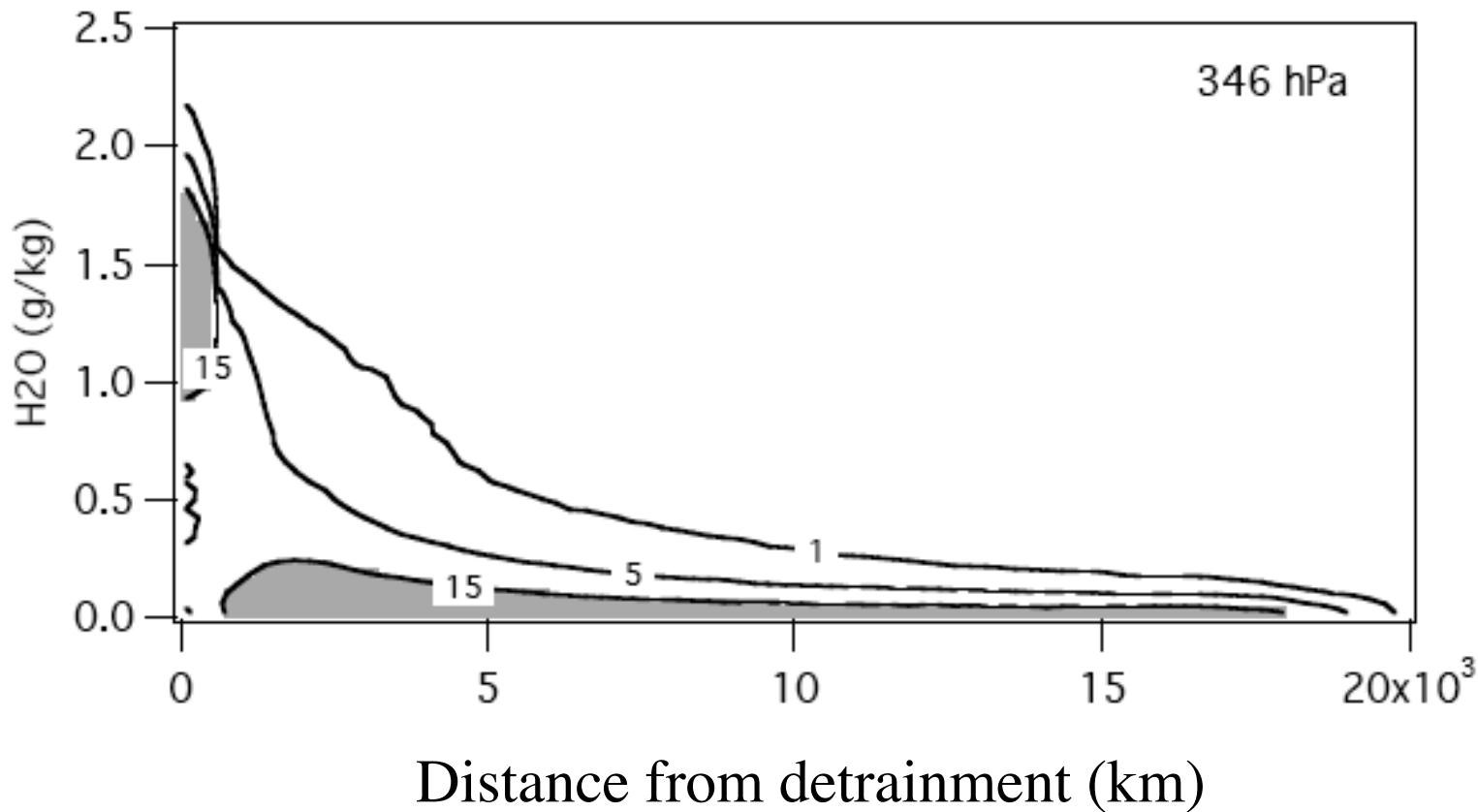
q 's effect on OLR





Dessler and Minschwaner
(2007), An analysis of the
regulation of tropical
tropospheric water vapor,
J. Geophys. Res., in press.

Dessler and Minschwaner (2007), An analysis of the regulation
of tropical tropospheric water vapor, *J. Geophys. Res.*, in press.



Conclusions

- OLR calculated using AIRS measurements agrees with CERES measurements within $\sim 5 \text{ W/m}^2$
 - Agreement best in the deep tropics and worst in the subtropics
- We are also studying the mechanisms that regulate clear-sky OLR
- T and q are the most important factors
 - T dominates below 298 K, q dominates above

This work was supported by a NASA EOS/IDS grant and by a NASA Aqua, Terra, ACRIM data analysis grant, both to Texas A&M